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PSMA PET/MR is a New Imaging Option for Identifying Glioma Recurrence and Predicting Prognosis

Min Xiong [1 2], Zhenghe Chen [1 3], Chao Zhou [1 2], Xiaochun Yang [1 2], Wanming Hu [1 4], Yongluo Jiang [1 2], Rongliang Zheng [1 2], Wei Fan [1 2], Yonggao Mou [1 3], Xiaoping Lin [1 2]

Affiliations

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Abstract

Background: Glioma is characterized by a high recurrence rate, while the results of the traditional imaging methods (including magnetic resonance imaging, MRI) to distinguish recurrence from treatment-related changes (TRCs) are poor. Prostate-specific membrane antigen (PSMA) (US10815200B2, Deutsches Krebsforschungszentrum, German Cancer Research Center) is a type II transmembrane glycoprotein overexpressed in glioma vascular endothelium, and it is a promising target for imaging and therapy.

Objective: The study aimed to assess the performance of PSMA positron emission tomography/magnetic resonance (PET/MR) for diagnosing recurrence and predicting prognosis in glioma patients.

Materials and methods: Patients suspected of glioma recurrence who underwent ^{18}F-PSMA-1007 PET/MR were prospectively enrolled. Eight metabolic parameters and fifteen texture features of the lesion were extracted from PSMA PET/MR. The ability of PSMA PET/MR to diagnose glioma recurrence was investigated and compared with conventional MRI. The diagnostic agreement was assessed using Cohen κ scores and the predictive parameters of PSMA PET/MR were obtained. Kaplan-Meier method and Cox proportional hazard model were used to analyze recurrence- free survival (RFS) and overall survival (OS). Finally, the expression of PSMA was analyzed by immunohistochemistry (IHC).

Results: Nineteen patients with a mean age of 48.11±15.72 were assessed. The maximum tumorto-parotid ratio (TPR_{max}) and texture features extracted from PET and T1-weighted contrast enhancement (T1-CE) MR showed differences between recurrence and TRCs (all p <0.05). PSMA PET/MR and conventional MRI exhibited comparable power in diagnosing recurrence with specificity and PPV of 100%. The interobserver concordance was fair between the two modalities (κ = 0.542, p = 0.072). The optimal cutoffs of metabolic parameters, including standardized uptake value (SUV, SUV_{max}, SUV_{mean}, and SUV_{peak}) and TPR_{max} for predicting recurrence were 3.35, 1.73, 1.99, and 0.17 respectively, with the area under the curve (AUC) ranging from 0.767 to 0.817 (all p <0.05). In grade 4 glioblastoma (GBM) patients, SUV_{max}, SUV_{mean}, SUV_{peak}, TBR_{max}, TBR_{mean}, and TPR_{max} showed improved performance of AUC (0.833-0.867, p <0.05). Patients with SUVmax, SUVmean, or SUVpeak more than the cutoff value had significantly shorter RFS (all p <0.05). In addition, patients with SUVmean, SUVpeak, or TPR_{max} more than the cutoff value had significantly shorter OS (all p <0.05). PSMA expression of glioma vascular endothelium was observed in ten (10/11, 90.9%) patients with moderate-to-high levels in all GBM cases (n = 6/6, 100%).

Conclusion: This primitive study shows multiparameter PSMA PET/MR to be useful in identifying glioma (especially GBM) recurrence by providing excellent tumor background comparison, tumor heterogeneity, recurrence prediction and prognosis information, although it did not improve the diagnostic performance compared to conventional MRI. Further and larger studies are required to

define its potential clinical application in this setting.

Keywords: MRI; PSMA PET/MR; glioma; prognosis.; recurrence; texture feature.